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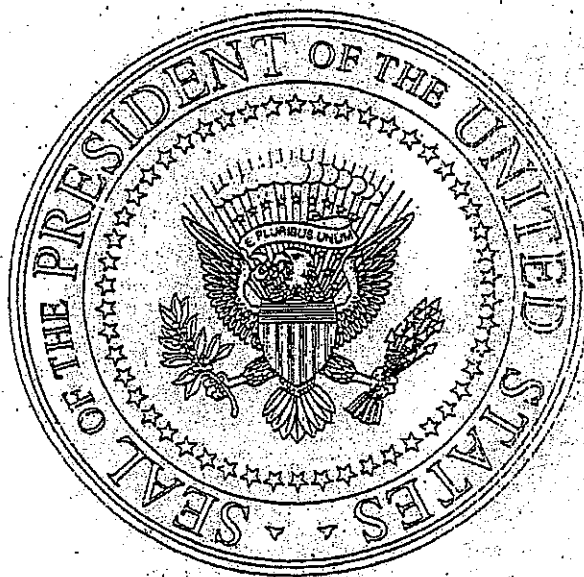
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# PRESIDENT CLINTON'S CLEAN WATER INITIATIVE:

## Analysis of Benefits and Costs



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## 17.0 Monetized Benefits: Urban Areas<sup>17</sup>

This section presents an estimate of the overall benefits that are likely to result from adoption of the Initiative's provisions that address urban sources of water pollution, including CSO, storm water, and toxics.

### 17.1 Introduction

The nation's lakes, rivers, bays, and oceans are enjoyed for their aesthetic qualities and for their recreation opportunities (e.g., fishing, waterfowl hunting, swimming, boating, and viewing). They also support a commercial fishing industry, and surface waters are diverted for food processing, other industrial uses (e.g., cooling), forestry, animal husbandry, and agriculture (e.g., irrigation). In addition to supplying these and other direct services for humans, the preservation of some aquatic ecosystems may provide nonuse or passive values. For example, these values may stem from the desires of the current generation to preserve certain ecosystems for the uses that future generations may have for them. Furthermore, some individuals believe that society has a stewardship responsibility even if the known uses for these particular ecosystems are unknown.

Surface waters have yet another use: as a waste receptacle for discharges from industry and run-off from both rural and urban areas. In spite of the great assimilative capacity of these waters, they can be degraded by excessive pollutant loadings to the detriment of the other beneficial uses to society. This section presents an estimate of the range of economic benefits that may result from adoption of the Initiative's provisions dealing with urban sources in the CWA. Due to uncertainties along each step of the process from implementation of the provisions to the resultant changes in water quality and finally to the effects on human welfare, the estimate of the economic benefit range may understate or overstate actual benefits.

### 17.1 Limitations

The analysis of the economic benefits focusing on urban areas draws upon information provided by a number of disparate data sources, and relies upon a number of assumptions. The synthesis of information introduces considerable uncertainty into the final numeric values. Major sources of uncertainty that limit our ability to be confident in the numeric results include: (1) the actual extent of impaired waters; (2) the method of attributing responsibility for impairment; (3) our assumptions about the efficacy of the provisions; and (4) the reliance upon secondary sources of information when estimating the economic values of environmental quality. The absence of reliable information on all of these elements plays a critical role in our ability to draw conclusions about the benefits that will result from the Initiative.

<sup>17</sup> See also the EPA (1994b) background paper "Aggregate Economic Benefits for Controlling Selected Urban-Based Pollution Sources," February 1994.

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One of the more significant points of uncertainty in the analysis relates to the monetary valuation of economic benefits for the dominant benefit category: the enhanced freshwater recreation, aesthetics, and non-use benefits that ensue with the proposed water quality improvements. The absence of alternative data sources constrained us to make use of a published, yet dated, contingent valuation research study that measured a household's use and non-use values for national and, by apportionment techniques, more localized improvements in freshwater rivers and lakes. Criticism has been levied against the validity of empirical results for non-use values derived using prior contingent valuation research methods. Several issues raised in the ongoing debate about this valuation method bear directly upon the interpretation of the numeric results provided by our source materials.

Independent of this debate, further uncertainties are introduced by transferring the research results to the policies and environmental concerns addressed by the Initiative. The wide range of values demonstrates an attempt to capture the impact of these uncertainties on the numeric estimate. All told, it is difficult to conclude whether the presented numeric ranges underestimate or overestimate the actual benefits. We suggest that the numerical results best serve to indicate the overall order-of-magnitude of the benefits. Based upon our experience in undertaking the analysis, we can further conclude that considerable gaps persist in our ability to measure and evaluate the relationships between water quality conditions and economic activities, even twenty years after the passage of the principal legislation designed to identify and address water pollution problems. The Administration's Initiative contains provisions to help rectify this situation in the future.

### 17.3 Methodology and Assumptions

This analysis begins with informed judgement about the extent of water quality improvement that may result from implementation of CSO and storm sewer provisions relative to current conditions. We assume that in all cases where CSOs or storm sewers are thought to be the leading source of impaired urban waters (i.e., based upon the 307(b) Reports), the implementation of these provisions will restore these waters to fishable and swimmable quality. Furthermore, for those waters where other sources must share significant responsibility with CSOs and storm sewers for precluding the attainment of fishable and swimmable quality, we assume two things. First, we attribute 50% of the responsibility to CSOs and storm sewers. Second, we assume that the implementation of other provisions of the act in combination with the CSO and storm sewer provisions will result in the attainment of fishable and swimmable quality in the affected waters. Thus, although we recognize that uncertainty about the actual extent of impaired waters may lead to an over or underestimate of the economic benefit range, our method of attributing responsibility for impairments and our assumptions about the efficacy of the provisions may tend to overestimate the economic benefit range.

Beyond the physical, chemical, and biological changes that may result from the CSO and storm sewer provisions, for the economic evaluation it is also necessary to estimate the effects these changes have on humans and other economic entities (i.e., industry). For the purposes of this assessment we aggregate these sources of benefits into four primary categories: 1. enhanced



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freshwater recreation, aesthetics, and nonuse benefits; 2. enhanced marine recreation, aesthetic, and nonuse benefits; 3. cost savings or increased output for withdrawal or diversionary users; and, 4. cost savings or increased output for commercial fisheries. In the event that human health effects were not subsumed in the benefit estimates of one or more of the four primary categories we include it as a fifth category. In addition to quantifying an economic benefit range for each of these categories, we mention the other potential changes in the economic activities of consumers and producers that could not be quantified.

The existing economic literature on the benefits of water quality improvements suggests that enhanced water-based recreation and aesthetics and the non-use values that people may hold for the preservation of the nation's aquatic ecosystems is the largest source of quantifiable economic benefits. The sheer numbers of people who recreate in a water setting each year testifies to the importance of this resource. More to the point, a growing number of economic studies are documenting the influence that water quality characteristics have on which water bodies people choose to visit, how often they engage in water-based recreation activities, and how much they are willing to pay for incremental improvements in water quality. Less abundant are the studies that demonstrate the linkage between water quality improvements and the resultant increases in individuals' non-use values, but there is general agreement that these values exist. This is based in part upon survey responses from people who do not currently use the nation's surface waters for recreation or for their aesthetics but nonetheless indicate a willingness to pay for achieving certain water quality standards.

There are no primary studies that attempt to estimate the enhanced recreation, aesthetics, and non-use benefits of water quality improvements that may be attributed to the C-30 and storm sewer provisions of the Initiative. However, there is a study that attempts to ascertain the total economic value that households place on the achievement of incremental improvements in virtually all of the nation's lakes, rivers, and streams (i.e., in the waters were not included) (Mitchell and Carson, 1984, 1986; Carson and Mitchell, 1993 and Lyon and Perrow, 1992). As a part of this research effort, a method of allocating the household's willingness to pay for improvements in local water quality was also devised. This method of apportioning total willingness to pay for subnational changes in water quality was "validated" by comparing the resultant estimates with those of studies that valued similar incremental improvements (i.e., from boatable to fishable and from fishable to swimmable) at the local level (Mitchell and Carson, 1986; Carson and Mitchell, 1993). Therefore, we use Mitchell and Carson's research to suggest the range in enhanced recreation, aesthetics and non-use benefits from improvements in urban freshwaters that may result from the Initiative. Key assumptions in this analysis involve: the number of households proximate to the improved waters versus all other households, the proportion of improved waters in the household's State relative to all of the State's degraded waters, the abundance of clean alternatives proximate to the household, the abundance of substitute clean waters in the state, and the accuracy of the original study. Uncertainty about each of these factors leads to a wide range for the economic benefit estimate. Moreover, to say whether the range itself underestimates or overestimates the actual benefits is impossible, especially when uncertainties about the actual physical water quality changes are factored into the analysis.

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The remaining quantifiable economic benefits (i.e., enhanced marine recreation, aesthetics, and non-use values; commercial fishing; water diversions; and human health) are small by comparison with the freshwater benefits. In addition, the economic basis for estimating these benefits is less defensible. We rely entirely upon secondary studies to suggest a plausible range of benefits for these categories. Finally, we mention briefly other possible economic benefits to people and economic entities that may or may not be subsumed in the foregoing analyses. We believe that mentioning these potential economic effects is important because we cannot rule them out on the basis of current knowledge. A more detailed discussion of how the benefits are quantified and monetized is included in Appendix D.

#### 17.4 Summary of Benefits Results

**Monetized Benefits: Urban Areas.** EPA estimates further that the aggregate benefits of pollution control in urban areas will eventually produce quantifiable benefits of between \$0.8 billion and 16.0 billion per year (Table 18). The range recognizes the uncertainty associated with these estimates. For example, the upper end of the range may tend to underestimate in the extreme case where the new provisions are 100 percent effective, households care very much about the resultant improvements relative to the other waters in their state, and the unquantified benefits turn out to be significant relative to the quantified benefits. Similarly, the lower end of the range may be an overestimate in the extreme event that the new provisions fail to improve water quality to fishable and swimmable levels, or the changes in water quality have no effect on the economic activities of consumers and producers.

**Quantified Benefit Categories.** The first beneficial category related to the total value that households place on the enhanced recreation, aesthetics, and non-use values associated with improved urban freshwaters. The most comprehensive assessment of such benefits is actually too inclusive. A contingent valuation study conducted by Mitchell and Carson (1984, 1986), and updated by Carson and Mitchell (1991, 1993) values freshwater quality improvements beyond the expanse of waters whose quality will be improved as a consequence of the urban provisions of the Initiative. However, Mitchell and Carson (1986) show how their research results can be used to value localized improvements such as may occur once the CSO, storm water, and other urban-based provisions are implemented. According to Mitchell and Carson (1986), respondents to their survey were willing to allocate 67% of their national willingness to pay to achieve improvements at the state level. Then, Mitchell and Carson (1986) devised guidelines for further reducing this percentage for sub-state water quality improvements.

To implement their strategy, we divided the population into two types of people; those living in urban areas proximate to the water quality change, and all other households. The allocation of households into these two groups was based upon an estimate of the number of households living in urban areas proximate to waters that have not attained fishable and swimmable conditions. The simulations from a water quality model that linked urban populations to waters in EPA's Reach File 1 (Bondelid and Cooter, 1995) provided an estimate of the urban populations that are proximate to impaired waters. By "proximate" is meant living in a city or town that has the same reach designation as the river segment. The 305(b) reports



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provided the estimate of the percentage of impaired urban waters that are due, at least in part, to CSOs, storm water, and other urban-based pollution. Ecol estimates were based upon nonrandom samples of their respective populations, and yet we used these estimates to extrapolate to the full national populations of households and freshwaters. Unfortunately, we do not know whether the effect of this extrapolation is to under- or over- estimate the number of households that are most proximate to improved waters.

The households living proximate to improved urban waters are likely to benefit most from the successful implementation of the urban provisions in the Initiative. We assign them a range of benefits using Mitchell and Carson's lower bound of 1% and upper bound of 67% of their total willingness to pay. The high end of the range is only appropriate if the improved waters represent virtually all of the previously degraded waters in the household's state and/or the households care most about their state waters they adjoin. Households not located along these improved waters are assigned a lower bound of 0% and an upper bound of 12%, as the improved waters are located further away and substitution possibilities are relatively abundant. For both types of households, the estimates are further reduced by 50% in cases where other sources of pollutants besides CSOs and storm water are assumed to be limiting factors that may preclude fishable and swimmable water quality conditions.

The number of urban households expected to directly benefit from improvements in their local waters are considerable. We estimate that 29 million urban households border waters currently incapable of supporting suitable fishing conditions, and 61 million households adjoin water that fail to meet criteria used to classify swimmable designated use conditions. Of these households, nearly 4 out of every 10 are expected to experience a full recovery of their waters to support these designated uses as a consequence of implementing the urban-based Initiative provisions. The remainder may see partial or no improvement because additional measures will be required to bring the affected waters to fishable and swimmable conditions, measures that are presently mandated under existing environmental statutes but have yet to be fully implemented.

The annual economic benefits to the first group of households expecting full recovery of their waters ranges from \$0.4 to \$2.0 billion. For households in those urban areas where these provisions will serve to eliminate some of the problems, when the remaining limiting factors are overcome, their benefits are expected to range between \$0.3 to \$1.6 billion. Lastly, the range of benefits to persons outside of these affected areas but expected to enjoy use or non-use benefits as a result of improvements in these areas is zero to \$1.1 billion. Adding these three categories of households, the consequences of bringing these urban area waters into designated fishable and swimmable water quality conditions yields a national total annual benefit estimate between \$650 million and \$4.7 billion. As can be seen, the majority of the monetary benefits are associated with those urban households that are located in areas having water quality problems.

The wide range in estimated benefits reflects, in part, the uncertainties in the analysis regarding the strength of these households' preferences for achieving improvements in their local impaired waters. Their values should be dependent upon the availability of possible substitutes,

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not founded on empirical research on relative loadings of pollutants from different sources occurring in these affected waters but is based on the informed judgement of EPA staff.<sup>2</sup>

### Findings Used for Analysis

- The Initiative's CSO, storm water and toxics provisions will be necessary and sufficient for restoring swimmable/fishable conditions in approximately 39% of the impaired water bodies proximate to urban populations.
- For the remaining 61% of impaired water bodies near urban populations, the Initiative's urban provisions will be necessary but insufficient to ensure improvements occur. The relative proportion of the impairment that can be attributed to these sources is assumed to be 50%. This figure will be used to attribute the anticipated economic benefits of improvements to the Initiative's policies that control urban nonpoint pollution sources.
- Therefore, 11.3 million urban households are expected to achieve swimmable conditions, and 16 million urban households are expected to achieve swimmable conditions solely due to the Initiative's CSO, storm water, and toxics provisions. This represents 100% of the estimated economic benefits of these improvements to the Initiative's provisions. The remaining 17.7 million urban households will see improvements in fishing from control of these and other pollution problems. Likewise, the remaining 23 million urban households will achieve improvements in their swimming conditions as a result of these provisions and other pollution control requirements. For these urban segments of the urban population, the benefits from these water quality changes will be partially apportioned (50% of the total benefits) to urban nonpoint control policies.

### 3. Economic Benefits from Initiative's CSO, Storm Water and Toxics Provisions

#### Facts

- Mitchell and Carson estimate the following willingness to pay for certain use and non-use recreational opportunities from water resource quality improvement:

#### Valuation:

- > Boatable to fishable \$104 (\$70\*1.33 inflation factor\*1.11 real income growth above adjustments)
- > Fishable to swimmable \$115 (\$78 above adjustments)

<sup>2</sup> Statistics on urban nonpoint loadings relative to total point and non-rural nonpoint loadings suggest that urban nonpoint loadings constitute a significant fraction of total pollution loadings. Using information on point source loadings and average wet weather conditions for the early 1990s, 39% of total suspended solids loadings originated from point sources and 61% from urban nonpoint sources.

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### Assumptions

- The Mitchell and Carson study is representative of actual willingness to pay.
- When calculating fishing benefits, assume that affected waters are already at boatable status. Likewise when calculating swimming benefits, assume that all affected waters have reached fishable status, either as a baseline condition or as a consequence of these policies. In doing this, we can aggregate the estimated benefits of improving fishing and swimming without fear of double-counting the economic benefits of achieving fishable or swimmable water quality conditions.
- We draw upon information from Carson and Mitchell on their surveyed households' allocation of economic benefits from the attainment of water quality conditions in the nation's freshwaters. As an upper bound estimate, we assume that for those urban households located in places having impaired water quality, that two-thirds of their national stated WTP for a particular level of use support (i.e., fishable or swimmable water quality) is directed at water quality improvements in their immediate area. As a lower bound estimate, we assume that these households are willing to allocate 12% of their total national stated WTP for local water quality improvements. Note that when a greater proportion of their WTP is directed at local waters, it follows that these same persons will not be willing-to-pay much for achieving the same fishing and swimming uses in remaining waters located beyond their immediate area.
- Where it is both necessary and sufficient to undertake the Initiative's urban provisions to attain improvement in fishing and swimming conditions, 100% of the benefits are attributed to these provisions. For those waters where it is necessary but not sufficient to undertake the Initiative's urban provisions to attain fishing and swimming uses, 50% of the benefits to households located near these waters are attributed to these provisions. In other words, the assignment of benefits to provisions in the Initiative is organized by source (e.g., CSOs, storm water), which is consistent with the information on the assignment or attribution of causes of impairment to sources identified in the Initiative.
- We use the Carson and Mitchell research to estimate the benefits to urban households not located by impaired urban waters and to all rural households of the water quality improvements that can be achieved as a result of the Initiative's urban provisions. As an upper bound, we assume that these households are willing to allocate 12% of their total national stated WTP for these water quality improvements. As a lower bound, we assume that they would be unwilling to allocate any part of their national WTP for these improvements. This is based, in part, upon Carson and Mitchell research on the non-urban survey respondents' stated WTP for improvements in all areas, as compared to improvements in all but the nation's urban areas. The incremental benefits to these persons for achieving fishable quality in urban areas could be zero, given the availability of substitutes and the relative fraction of the nation's waters that the affected urban waters constitute.

The results of these assumptions and analysis are summarized in Table D-3. Additional



information and issues to consider in using the freshwater recreational results.

#### **Reason To Think Values Could Be Underestimated**

- The Mitchell and Carson survey was conducted in 1983. If the survey was repeated, values might be higher today due to greater awareness of water quality conditions (publications), stronger preferences for water quality improvements (consumer survey results), and improved economic conditions.

#### **Reasons To Think Values Could Be Overestimated**

- Mitchell and Carson found that a sub-sample of respondents were almost as satisfied (based on WTP estimates) with partial improvements in waters as they were with achieving a 99% improvement. For example, non-urban respondents were WTP \$74 to make waters 95% fishable and \$80 to make waters 99% fishable. We assume that WTP is linearly related to overall national water quality. If the relationship is non-linear, then marginal values of improvements as one approaches virtually nationwide use attainment for a particular use could be overstated.
- Both professional and trade literature on contingent valuation issues and Federal agency deliberations on the use of contingent valuation research for developing economic measures of proposed regulatory and damage award purposes cite serious concerns regarding the reliability of economic values based upon responses to survey questions. The majority of critical reviews of contingent valuation research suggest that these survey responses are larger than monitored cash payments made to achieve the desired outcome (Arrow, et al., 1993; Cambridge Economics, 1992; and Cornblith and Parsons, 1991). For this and other reasons, some persons within the economic and policy analysis community are reluctant to make use of contingent valuation research that has not been conducted using a number of recommended operating structures that are designed to provide for more reliable empirical estimates. The Mitchell and Carson study referenced here does not conform to the full set of these recommendations, and thus may be considered too unreliable for use as a reference for this analysis.

#### **Additional Uncertainty**

- Mitchell and Carson's survey instrument elicited total willingness-to-pay estimates for nationwide changes in water quality conditions. The need to disaggregate the national estimates to local waters and to assign some portion of these estimates to localized changes is severely constrained by the information contained in the survey. As a result, the attempt to distribute the values to local waters goes beyond information contained in the author's report. If the assumptions made here are incorrect, they can substantially affect the household and national estimates of the benefits of improving

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Table D-3

## Estimated National Swimming and Fishing Benefits to Controlling Urban Sources, National (1992 dollars)

Households Benefiting From Water Quality Improvements Attributable to the Initiative's Urban Provisions	Lower Bound National Benefit Estimate: For affected urban households, use 12% of national WTP; for non-affected households, use 0% of national WTP.	Upper Bound National Benefit Estimate: For affected urban households, use 67% of national WTP; for non-affected households, use 24% of national WTP.
Affected urban population where urban sources are sufficient (assign 100% of benefits) to relieve cause of impairments: 39% of impaired urban waters	<p>Fishing: 11.3 million households @ \$12.5/household = \$141 million</p> <p>Swimming: 16 million households @ \$13.8/household = \$221 million</p> <p><b>TOTAL = \$365 million</b></p>	<p>Fishing: 11.3 million households @ \$69.7/household = \$788 million</p> <p>Swimming: 16 million households @ \$77.1/household = \$1,234 million</p> <p><b>TOTAL = \$2,022 million</b></p>
Affected urban population where urban sources are necessary but not sufficient (assign 50% of benefits) to relieve cause of impairments: 61% of impaired urban waters	<p>Fishing: 17.7 million households @ \$12.5/household * (50 percent) = \$111 million</p> <p>Swimming: 25 million households @ \$13.8/household * (50 percent) = \$173 million</p> <p><b>TOTAL = \$284 million</b></p>	<p>Fishing: 17.7 million households @ \$69.7/household * (50 percent) = \$617 million</p> <p>Swimming: 25 million households @ \$77.1/household * (50 percent) = \$964 million</p> <p><b>TOTAL = \$1,581 million</b></p>
Other population (rural and unaffected urban households) WTP to see attainment of fishing and swimming uses in impaired in-state urban waters	Fishing and swimming: \$0	<p>Fishing: 41.6 million (urban) + 23.2 million (rural) households @ \$12.5/household * (100%*39% + 50%*41%) = \$363 million</p> <p>Swimming: 23.6 million (urban) + 17.2 million (rural) households @ \$13.8/household * (100%*39% + 50%*41%) = \$805 million</p> <p><b>TOTAL = \$1,169 million</b></p>
Total WTP Estimate	<b>Lower Bound: \$649 million</b>	<b>Upper Bound: \$4,672 million</b>

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the identified sample of urban waters. For example, survey responses tried to distinguish in-state and out-of state values. Whether these values are distributed equally among all waters or would be focused on specific waters (e.g., those having known unique habitat or having significant economic value) is not contained in the survey results.

- Mitchell and Carson focus only on freshwaters. The survey expressly asks that respondents do not consider marine waters in their answers. Nevertheless, it is possible that respondents may have included some marine waters in describing their WTP. No test was conducted to elicit whether respondents truly considered this in their responses.
- The survey attempted clarify that drinkable water quality was distinctly different from swimmable water quality. However, it is unclear to what extent responses could be associated with improvements beyond swimmable. For example, some aquatic uses may still be impaired, even though the waters are swimmable.
- Limited research suggests that individual fishermen may be willing to pay to move fishable waters to levels that provide for the consumption of fish. If correct values could possibly be adjusted upward to account for this additional value if not incorporated into the responses.
- The analysis relies on information and assumptions that are used to attribute changes in water quality conditions (and economic benefits) to anticipated changes in loadings of pollutants from urban sources. If these assumptions are incorrect, then the attribution of benefits to these programs when following this methodology will result in an incorrect estimate of the quantified benefits from these provisions.

### MARINE WATER-SPECIFIC CATEGORIES

#### 1. Baseline Marine Water Resource Quality

- 24% of water bodies in urban areas are fully supporting their designated uses, which compares with 56% of estuaries nationwide that are fully supporting their designated uses. 80% of coastal waters are fully meeting their designated uses.
- At the national level, 22% of estuaries are partially or not supporting aquatic life use support, 5% are partially or not supporting fish consumption, 30% are partially or not supporting shellfishing, and 17% are partially or not supporting swimming.

#### 2. Marine Water Quality Improvement from Initiative's CSO, Storm Water, and Toxics Provisions

- At the national level, urban runoff and storm sewers are the leading source of impairment in 43% of the estuaries and 58% of coastal areas.